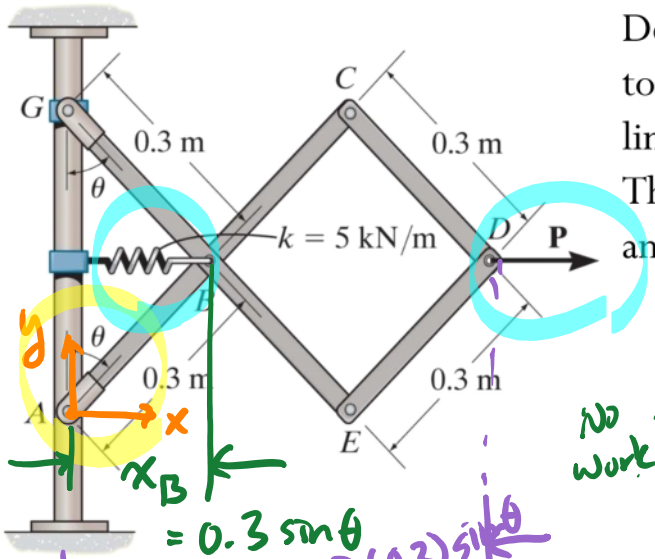
Announcements

- CBTF Quiz 5 retry starts tomorrow (Thursday)
- Last day of class: Monday, April 29
- No discussion sections next week
- Last day of office hours and Piazza help: Wednesday, May 1
- CBTF (last) Quiz 6 starts Thursday, May 2

❑ Upcoming deadlines:

- Friday (4/26): Written Assignment
- Wednesday (5/1): Last PL HW

Wednesday, April 24, 2019 10:06 AM



Determine the required force P needed to maintain equilibrium of the scissors linkage when the angle is 60 degrees. The spring is unstretched when the angle is 30 degrees.

$= 0.3 \sin\theta$

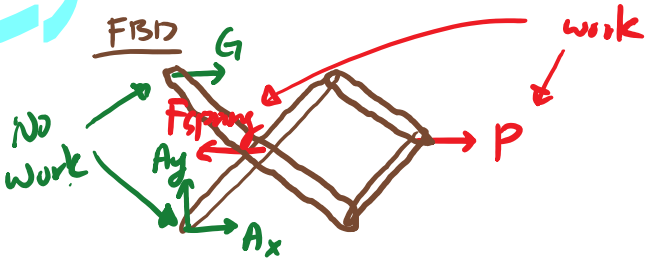
$x_D = 3(0.3)\sin\theta$

$F_{spring} = ks = k(l - l_0)$

$l_0 = 0.3 \sin 30°$

$l = 0.3 \sin\theta$

$\rightarrow F_{spring} = k(0.3)(\sin\theta - \sin 30°)$



Virtual Work

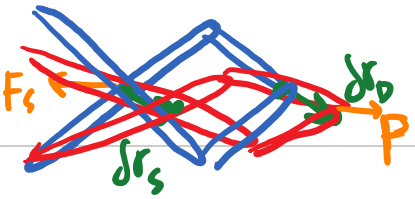
$\Sigma dU = 0 = dU_{spring} + dU_P$

$dU_{spring} = \vec{F}_{spring} \cdot \delta\vec{r}_B$

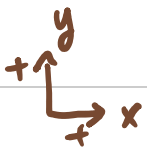
or $= F_{spring}\, \delta x_B$

$dU_P = \vec{P} \cdot \delta\vec{r}_D$

or $= P\, \delta x_D$



$\frac{\delta}{\delta\theta}(x_B) = 0.3\cos\theta$



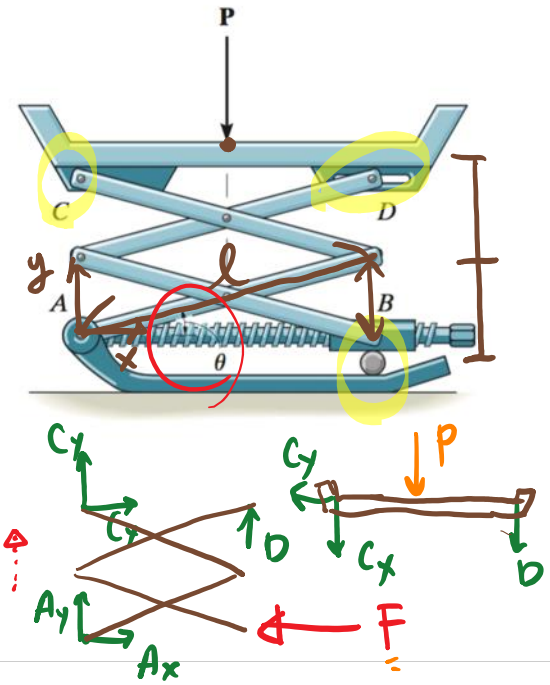
$\frac{\delta}{\delta\theta}(x_D) = 0.9\cos\theta$

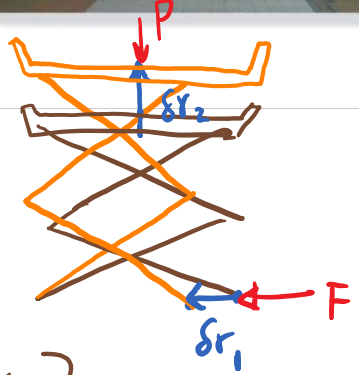
$\Sigma dU = 0 = -k(0.3)(\sin\theta - \sin 30°)(0.3\cos\theta) + P(0.9\cos\theta)$

$k(0.3)(\sin\theta - \sin 30°)(0.3\cos\theta) = 0.9P\cos\theta$

$\sin\theta - \sin 30° = \frac{0.9P}{(0.3)(0.3)k} \rightarrow \boxed{\sin\theta = \frac{10P}{k} + \sin 30°}$

The scissors jack supports a load **P**. Determine the axial force in the screw necessary for equilibrium when the jack is in the position shown. Each of the four links has a length L and is pin-connected at its center. Points B and D can move horizontally.





$\delta U_P = -P\,\delta y_2$

$\delta U_F = -F\,\delta x_1$

$x_1 = \ell\cos\theta \rightarrow \frac{\delta x_1}{\delta\theta} = -\ell\sin\theta$

$y_2 = 2\ell\sin\theta \rightarrow \frac{\delta y_2}{\delta\theta} = 2\ell\cos\theta$

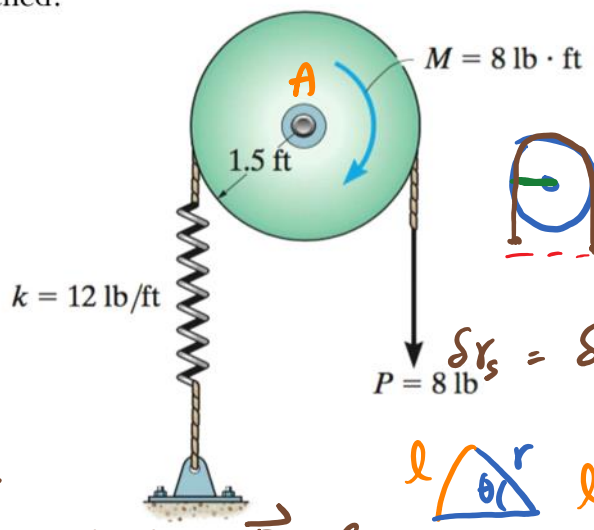
$-P(2\ell\cos\theta) + (-F)(-\ell\sin\theta) = 0$

$P = \frac{F}{2}\tan\theta$

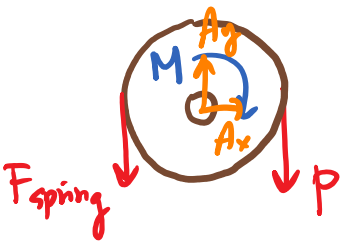
$\theta \le 45°$ 가 $\theta = 45°$, $\tan\theta = 1$.

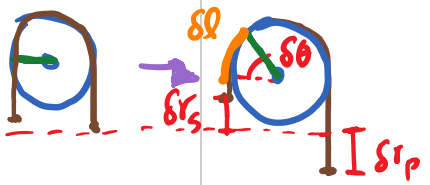
$P = \frac{F}{2}$

The disk has a weight of 10 lb and is subjected to a vertical force P = 8 lb and a couple moment M = 8 lb ft. Determine the disk's rotation u if the end of the spring wraps around the periphery of the disk as the disk turns. The spring is originally unstretched.



FBD





$\delta r_s = \delta r_p = \delta l = (1.5\text{ ft})\,\delta\theta$

$l = r\theta$ ← [rad]

Virtual Work Eqn

$$\Sigma dU = 0 = \vec{F}_{spring} \cdot \delta\vec{r}_s + M\,\delta\theta + \vec{P} \cdot \delta r_p$$

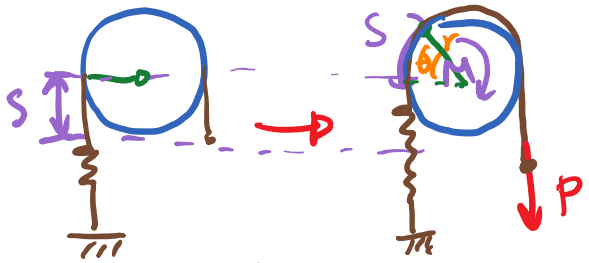
$F_{spring} = ks$

$\delta\vec{r}_s = ? = (1.5\text{ ft})\,\delta\theta$

$\delta\vec{r}_p = ? = (1.5\text{ ft})\,\delta\theta$

$\delta\theta$ ✓

$$\left[-(ks)(1.5\,\delta\theta) + M\,\delta\theta + P(1.5\,\delta\theta) = 0\right]\frac{1}{\delta\theta}$$



$$s = \frac{M + 1.5P}{1.5k}$$

$\rightarrow \quad s = r\theta \rightarrow \quad \theta = \frac{s}{r}$ ✓